BOSTON REGION METROPOLITAN PLANNING ORGANIZATION
Richard A. Davey, MassDOT Secretary and CEO and MPO Chairman
Karl H. Quackenbush, Executive Director, MPO Staff

MEMORANDUM

DATE **April 20, 2011**

TO **Congestion Management Program Files**

FROM **Ariel Godwin, CMP Manager**
Boston Region MPO Staff

RE **Limited-Access Highway Vehicle Occupancy Counts and Traffic Volumes, Summer 2010**

This memorandum presents the results of summer 2010 vehicle occupancy counts. Vehicle occupancy count data are collected as part of the Congestion Management Process (CMP) work program. The CMP is an ongoing multimodal MPO program that has been funded (formerly under various other names) by the Boston Region MPO since 1995. The CMP's tasks include collecting performance data about the region's transportation system, identifying causes of recurring congestion, and developing recommendations for congestion-reducing strategies that can be implemented through projects funded in the MPO's Transportation Improvement Program (TIP). In addition, the CMP supports the MPO's Long-Range Transportation Plan (LRTP) by providing data for needs assessment and recommending strategies for the LRTP. Data collected as part of the CMP can also be used for transportation modeling.

STUDY DESCRIPTION

In the fiscal year 2011 Unified Planning Work Program (UPWP), the CMP work program was updated to include monitoring of vehicle occupancies. The purpose of this monitoring is to provide data for future HOV system planning and other transportation-demand-management work. The vehicle occupancy counts from general-purpose lanes described in this memo may be particularly useful for HOV system planning. Currently the freeway sections in which data were collected do not have HOV lanes.

Vehicle occupancy data collection took place between June 15 and July 7, 2010, at seven locations:

1. Route 3, northbound, between exits 15 and 16 in Weymouth
2. Route 24 northbound near the I-93 ramps in Randolph
3. Route 24 southbound near the I-93 ramps in Randolph
4. I-90 eastbound between exits 13 and 14 in Natick
5. I-95, northbound, between exits 30A and 30B in Lexington
6. I-93, northbound, between exits 41 and 42 in Wilmington

7. I-93, southbound, between exits 41 and 42 in Wilmington

Data collection took place in the morning (7:00 – 9:00 AM) for inbound traffic (in the direction of downtown Boston) and in the afternoons (4:00 – 6:00 PM) for outbound traffic. Data were collected by MPO staff; each staff member monitored one lane and recorded the number of occupants in each vehicle that passed using a mechanical tally counting board.

Data collection presented some challenges. In particular, a visual assessment of how many people are in a passing vehicle can be challenging depending on factors such as lighting conditions, vehicle speed, and vehicle window tinting. Also, given the limited-access design of freeways and the high speed of traffic, it was difficult to find a safe location, with clear lines of sight, from which to collect data. The safety of the data collectors was a significant factor in the choice of locations. To this end, rest stop locations were sought for observers to park their vehicles and also have a clear sight distance. For four of the seven locations at which data were collected, a MassDOT van was required in order to assure adequate safety.

Assumptions

Because of the difficulty, or in some cases impossibility, of counting the number of occupants inside certain types of vehicles, the following assumptions were made when calculating the average vehicle occupancy numbers:

- Vehicles in the “5+ Persons” category were assumed to have an occupancy of 5.5.
- Microbuses were assumed to have an occupancy of 10.
- Buses were assumed to have an occupancy of 25.
- Police, fire, and EMT vehicles were assumed to have an occupancy of 2.
- Vehicles in the “Not Known” category were assumed to have an occupancy of 2. This includes limousines and other vehicles with blacked-out windows and vehicles for which visibility did not permit an accurate count.

These assumptions were developed by staff. Although they are not necessarily specific to the locations, it was not possible to develop any more location-specific assumptions for these particular vehicle types.

RESULTS BY LOCATION

Figure 1 shows the count locations, as well as the locations of the HOV lanes. Locations are in geographical order clockwise from southeast to north.

Route 3 Northbound

Table 1 shows summer 2010 vehicle occupancy data for Route 3 northbound, between exits 15 and 16 in Weymouth.

- Data were collected on June 15, between 7:00 AM and 9:00 AM.
- At this location, there are two general-purpose lanes and one breakdown lane, which is used for general-purpose traffic from 6:00 AM to 10:00 AM.
- The hourly volumes ranged between 2,706 and 3,259 vehicles, totaling 5,965 vehicles during the two-hour period.
- The occupancy rate for each lane was 1.22 persons per vehicle.
- Approximately 7,279 persons in 5,965 vehicles were counted.

Route 24 Northbound

Table 2 shows summer 2010 vehicle occupancy data for Route 24, at the construction site near the I-93 ramps in Randolph, in the northbound direction.

- Data were collected on July 7, between 7:00 AM and 9:00 AM.
- There are three general-purpose lanes at this location.
- The hourly volumes ranged from 4,381 to 4,731 vehicles, totaling 9,112 vehicles during the two-hour period.
- The average vehicle occupancy across all three lanes was 1.24 persons per vehicle.
- Approximately 11,284 persons in 9,112 vehicles were counted.
- A MassDOT van was needed for safe data collection at this location.

Route 24 Southbound

Table 3 shows summer 2010 vehicle occupancy data for Route 24, at the construction site near the I-93 ramps in Randolph, in the southbound direction.

- Data were collected on June 29, between 4:00 PM and 6:00 PM.
- There are three general-purpose lanes at this location.
- The hourly volumes ranged from 5,418 to 5,660 vehicles, totaling 11,078 vehicles during the two-hour period.
- The average vehicle occupancy across all three lanes was 1.30 persons per vehicle.
- Approximately 14,384 persons in 11,078 vehicles were counted.
- A MassDOT van was needed for safe data collection at this location.

I-90/Mass Turnpike Eastbound

Table 4 shows summer 2010 vehicle occupancy data for I-90/Mass Turnpike, eastbound, between exits 13 and 14 in Natick.

- Data were collected on June 23, between 7:00 AM and 9:00 AM.
- There are three general-purpose lanes at this location.
- The hourly volume ranged between 4,176 and 5,032 vehicles, totaling 9,208 vehicles during the two-hour period.
- The average vehicle occupancy across all three lanes was 1.19 persons per vehicle.
- Approximately 10,912 persons in 9,208 vehicles were counted.

I-95 Northbound

Table 5 shows summer 2010 vehicle occupancy data for I-95 in Lexington, between exits 30A and 30B, in the northbound direction.

- Data were collected on June 22, between 4:00 PM and 6:00 PM.
- There are four general-purpose lanes at this location.
- The hourly volumes ranged from 5,089 to 5,287 vehicles, totaling 10,376 vehicles during the two-hour period.
- The average vehicle occupancy across all four lanes was 1.14 persons per vehicle.
- Approximately 11,794 persons in 10,376 vehicles were counted.

I-93 Northbound

Table 6 shows summer 2010 vehicle occupancy data for I-93 in Wilmington, at the emergency pullout between exits 41 and 42, in the northbound direction.

- Data were collected on July 7, between 4:00 PM and 6:00 PM.
- There are four general-purpose lanes at this location.
- The hourly volumes ranged from 6,398 to 6,645 vehicles, totaling 12,843 vehicles during the two-hour period.
- The average vehicle occupancy across all four lanes was 1.24 persons per vehicle.
- Approximately 15,936 persons in 12,843 vehicles were counted.
- A MassDOT van was needed for safe data collection at this location.

I-93 Southbound

Table 7 shows summer 2010 vehicle occupancy data for I-93 in Wilmington, at the emergency pullout between exits 41 and 42, in the southbound direction.

- Data were collected on June 29, between 7:00 AM and 9:00 AM.
- There are four general-purpose lanes at this location.
- The hourly volumes ranged from 5,106 to 6,524 vehicles, totaling 11,630 vehicles during the two-hour period.
- The average vehicle occupancy across all four lanes was 1.11 persons per vehicle.
- Approximately 12,858 persons in 11,630 vehicles were counted.
- A MassDOT van was needed for safe data collection at this location.

CONCLUSIONS

Table 8 shows a summary of the results from summer 2010 freeway vehicle-occupancy counts. Route 24 southbound had the highest average weighted vehicle occupancy (1.3), while I-93 southbound had the lowest (1.11).

The slightly higher occupancy counts on Route 3 and Route 24 may be partially explained by the proximity of the count locations to the southern end point of the Southeast Expressway HOV lane. At these locations, it may be assumed that a large proportion of northbound morning traffic was headed toward downtown Boston via the Southeast Expressway. The availability of an HOV lane along the Southeast Expressway may give drivers an incentive to seek higher-occupancy commuting options. The same is true for southbound afternoon traffic on Route 24; a significant proportion of vehicles may have come from the HOV lane.

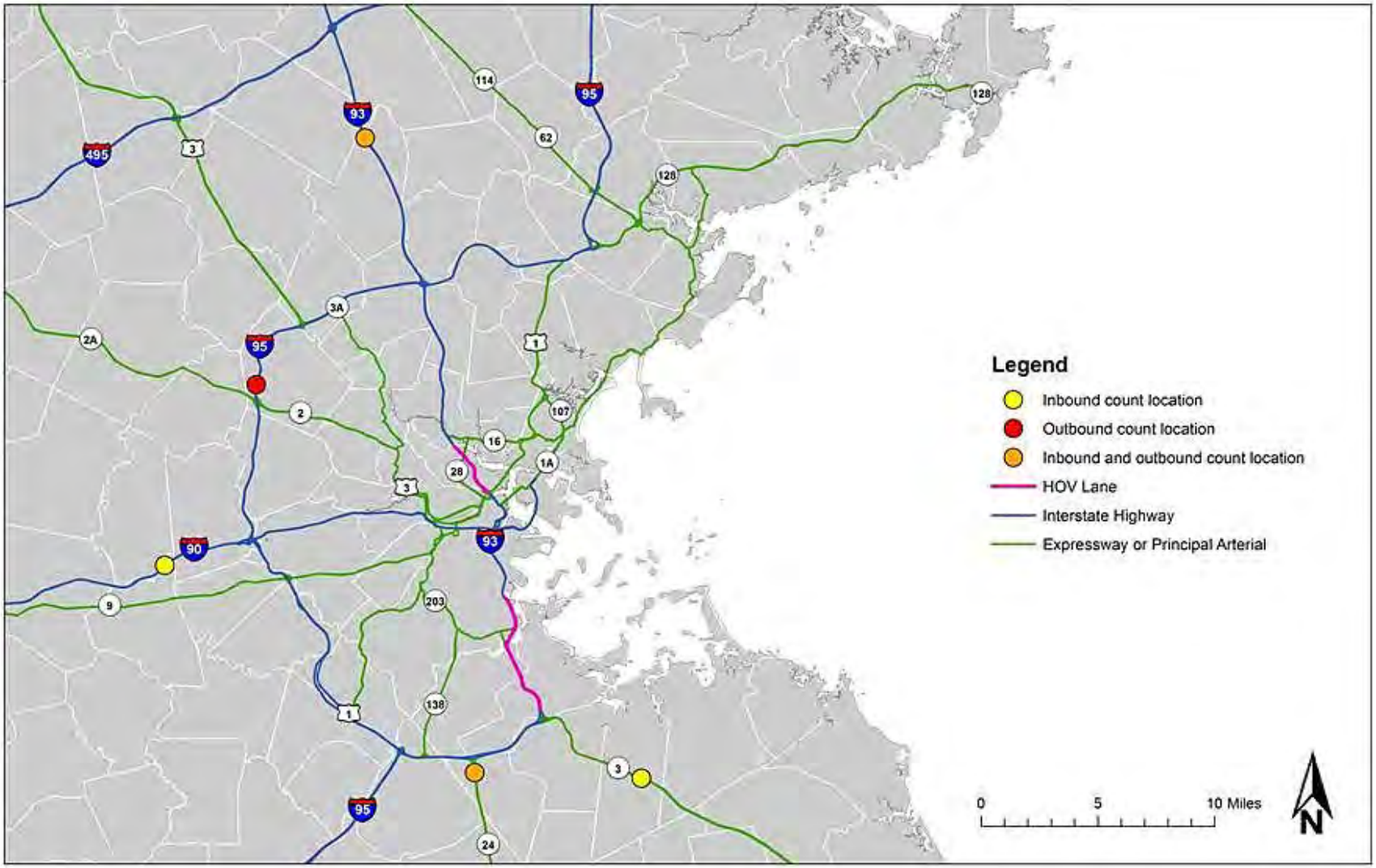
The same effect was not observed at the I-93 location. Although traffic at this location was headed toward the I-93 North HOV lanes, occupancy here was the lowest (1.11). However, the count location is much farther from the I-93 North HOV lane, and would have captured traffic headed for I-95 as well.

I-93 in the southbound direction also had the highest percentage of single-occupant vehicles (93%), while Route 24 southbound had the lowest (80%). Percentages of two-occupant vehicles were highest at Route 24 southbound (17%), Route 24 northbound (12%), and I-93 northbound (12%), again suggesting HOV lanes have an impact on commuting decisions.

Results from the HOV monitoring performed by staff in the fall of 2010 may reinforce this conclusion (see Appendices 1 and 2[1]). The Southeast Expressway general-purpose lanes and HOV lanes were last monitored from 6:00 AM to 10:00 AM on Tuesday, November 16, 2010. Between 7:00 AM and 9:00 AM, the average weighted vehicle occupancy (using the same weightings as were used for the general-purpose freeway occupancy counts described in this memo) was 2.60 for the northbound HOV lanes and 1.09 for the northbound general-purpose lanes. Assuming that both the summer 2010 freeway occupancy counts and the fall 2010 HOV lane occupancy counts represent typical morning traffic, it can be inferred that a substantial number of 2+ person vehicles counted at the Route 3 and Route 24 locations were headed to or from the HOV lanes.

For the counts done on June 29 and July 7, it is possible that holiday-related travel around the weekend of July 4th resulted in higher numbers of high-occupancy vehicles than normal, creating some bias in the data. However, efforts were made to avoid bias by scheduling counts during the middle of the week (Tuesdays and Wednesdays) and at least one day before or after the official holiday weekend.

[1] The two appended tables are from the memorandum, “Observed Travel Times, Vehicle Occupancies, and Travel Time Savings: I-93 North and Southeast Expressway High-Occupancy-Vehicle Lanes, Fall 2010” (Central Transportation Planning Staff, December 16, 2010), pp. 6 and 8.



BOSTON REGION MPO

FIGURE 1
Limited-Access Highway Occupancy Count Locations
Summer 2010

Congestion Management Process

TABLE 1
Route 3 Northbound Vehicle Occupancy Counts
June 15, 2010
7:00 – 9:00 AM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
7:00–8:00 AM	2,882	314	28	4	3	9	7	3	9	**3,259**	**3,916**	**1.20**
8:00–9:00 AM	2,352	309	14	2	0	4	11	1	13	**2,706**	**3,363**	**1.24**
TOTAL 7:00–9:00 AM	5,234	623	42	6	3	13	18	4	22	**5,965**	**7,279**	**1.22**

*Includes motorcycles, unmarked police vehicles, and taxis without passengers.
**Includes limousines and other vehicles with blacked-out windows and vehicles for which visibility did not permit an accurate count.
***Assumes vehicle occupancies of 5.5 for 5+ vehicles, 10 for microbus, 25 for bus, and 2 for “Police/Fire/EMT” and “Not Known.”

TABLE 2
Route 24 Northbound Vehicle Occupancy Counts
July 7, 2010
7:00 – 9:00 AM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
7:00-8:00 AM	4,003	569	53	8	3	12	9	10	64	**4,731**	**5,842**	**1.23**
8:00-9:00 AM	3,626	559	77	16	5	11	4	10	73	**4,381**	**5,443**	**1.24**
TOTAL 7:00-9:00 AM	7,629	1,128	130	24	8	23	13	20	137	**9,112**	**11,284**	**1.24**

TABLE 3
Route 24 Southbound Vehicle Occupancy Counts
June 29, 2010
4:00 – 6:00 PM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
4:00–5:00 PM	4,419	992	121	27	13	18	5	3	62	**5,660**	**7,381**	**1.30**
5:00–6:00 PM	4,393	839	80	26	1	10	15	3	51	**5,418**	**7,004**	**1.29**
TOTAL 4:00–6:00 PM	8,812	1,831	201	53	14	28	20	6	113	**11,078**	**14,384**	**1.30**

TABLE 4
I-90/Mass. Turnpike Eastbound Vehicle Occupancy Counts
June 23, 2010
7:00 – 9:00 AM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
7:00–8:00 AM	4,369	592	48	8	0	4	6	5	0	**5,032**	**5,929**	**1.18**
8:00–9:00 AM	3,711	401	40	5	0	2	12	5	0	**4,176**	**4,983**	**1.19**
TOTAL 7:00–9:00 AM	8,080	993	88	13	0	6	18	10	0	**9,208**	**10,912**	**1.19**

TABLE 5
I-95 Northbound Vehicle Occupancy Counts
June 22, 2010
4:00 – 6:00 PM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
4:00–5:00 PM	4,704	496	46	5	0	0	8	1	27	**5,287**	**6,110**	**1.16**
5:00–6:00 PM	4,694	344	15	4	0	2	7	1	22	**5,089**	**5,684**	**1.12**
TOTAL 4:00–6:00 PM	9,398	840	61	9	0	2	15	2	49	**10,376**	**11,794**	**1.14**

TABLE 6
I-93 Northbound Vehicle Occupancy Counts
July 7, 2010
4:00 – 6:00 PM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
4:00–5:00 PM	5,342	802	65	27	8	32	7	3	112	**6,398**	**8,018**	**1.25**
5:00–6:00 PM	5,362	792	63	16	6	17	6	10	173	**6,445**	**7,918**	**1.23**
TOTAL 4:00–6:00 PM	10,704	1,594	128	43	14	49	13	13	285	**12,843**	**15,936**	**1.24**

TABLE 7
I-93 Southbound Vehicle Occupancy Counts
June 29, 2010
7:00 – 9:00 AM

Start Time	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Average Weighted Vehicle Occupancy
7:00-8:00 AM	6,085	396	17	0	0	5	8	3	10	**6,524**	**7,204**	**1.10**
8:00-9:00 AM	4,722	336	27	2	0	8	3	3	5	**5,106**	**5,654**	**1.11**
TOTAL 7:00-9:00 AM	10,807	732	44	2	0	13	11	6	15	**11,630**	**12,858**	**1.11**

TABLE 8
Summary of Results from Summer 2010 Freeway Vehicle Occupancy Counts

Location	Direction of Traffic	Date of Data Collection	Time of Data Collection	Number of Lanes	Total Vehicles	Total Persons	Average Weighted Vehicle Occupancy	Percent of Vehicles with 1 Person	Percent of Vehicles with 2 Persons
Route 3	Northbound	Tuesday, June 15, 2010	7:00–9:00 AM	3 (including breakdown)	5,965	7,279	1.22	88%	10%
Route 24	Northbound	Wednesday, July 7, 2010	7:00–9:00 AM	3	9,112	11,284	1.24	84%	12%
Route 24	Southbound	Tuesday, June 29, 2010	4:00–6:00 PM	3	11,078	14,384	1.30	80%	17%
I-90/Mass. Turnpike	Eastbound	Wednesday, June 23, 2010	7:00–9:00 AM	3	9,208	10,912	1.19	88%	11%
I-95	Northbound	Tuesday, June 22, 2010	4:00–6:00 PM	4	10,376	11,794	1.14	91%	8%
I-93	Northbound	Wednesday, July 7, 2010	4:00–6:00 PM	4	12,843	15,936	1.24	83%	12%
I-93	Southbound	Tuesday, June 29, 2010	7:00–9:00 AM	4	11,630	12,858	1.11	93%	6%

Appendix 1
I-93 Southeast Expressway Northbound General-Purpose and HOV Lane Vehicle Occupancy Counts
November 16, 2010

Lane Type	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Vehicle Occupancy
Time				**6:00–7:00 AM**								
HOV	4	1,027	128	10	7	14	21	9	6	*1,226*	*3,216*	*2.62*
General	5,222	228	15	1	0	7	13	4	16	*5,506*	*6,162*	*1.12*
All	**5,226**	**1,255**	**143**	**11**	**7**	**21**	**34**	**13**	**22**	***6,732***	***9,378***	***1.39***
Time				**7:00–8:00 AM**								
HOV	15	1,044	75	9	3	23	18	8	1	*1,196*	*3,079*	*2.57*
General	4,198	224	11	1	0	6	6	4	30	*4,480*	*4,961*	*1.11*
All	**4,213**	**1,268**	**86**	**10**	**3**	**29**	**24**	**12**	**31**	***5,676***	***8,040***	***1.42***
Time				**8:00–9:00 AM**								
HOV	5	864	88	14	3	9	19	8	0	*1,010*	*2,651*	*2.62*
General	4,182	214	9	5	0	4	2	6	24	*4,446*	*4,807*	*1.08*
All	**4,187**	**1,078**	**97**	**19**	**3**	**13**	**21**	**14**	**24**	***5,456***	***7,458***	***1.37***
Time				**9:00–10:00 AM**								
HOV	8	765	25	5	2	10	19	2	0	*836*	*2,223*	*2.66*
General	4,962	334	15	2	0	11	9	6	3	*5,342*	*6,036*	*1.13*
All	**4,970**	**1,099**	**40**	**7**	**2**	**21**	**28**	**8**	**3**	***6,178***	***8,259***	***1.34***
Time				**6:00–10:00 AM**								
HOV	*32*	*3,700*	*316*	*38*	*15*	*56*	*77*	*27*	*7*	*4,268*	*11,168*	*2.62*
General	*18,564*	*1,000*	*50*	*9*	*0*	*28*	*30*	*20*	*73*	*19,774*	*21,966*	*1.11*
All	***18,596***	***4,700***	***366***	***47***	***15***	***84***	***107***	***47***	***80***	***24,042***	***33,134***	***1.38***

Appendix 2
I-93 Southbound General-Purpose and HOV Lane Vehicle Occupancy Counts
November 17, 2010

Lane Type	1 Person*	2 Persons	3 Persons	4 Persons	5+ Persons	Micro bus	Bus	Police/ Fire/ EMT	Not Known**	Total Vehicles	Total Persons***	Vehicle Occupancy
Time				**6:00–7:00 AM**								
HOV	126	588	6	0	0	11	12	1	0	*744*	*1,732*	*2.33*
General	2,814	67	3	0	0	4	15	4	50	*2,957*	*3,480*	*1.18*
All	**2,940**	**655**	**9**	**0**	**0**	**15**	**27**	**5**	**50**	***3,701***	***5,212***	***1.41***
Time				**7:00–8:00 AM**								
HOV	105	615	22	2	0	5	23	4	0	*776*	*2,042*	*2.63*
General	2,711	56	1	0	0	5	3	5	16	*2,797*	*2,993*	*1.07*
All	**2,816**	**671**	**23**	**2**	**0**	**10**	**26**	**9**	**16**	***3,573***	***5,035***	***1.41***
Time				**8:00–9:00 AM**								
HOV	168	586	12	2	0	4	23	3	0	*798*	*2,005*	*2.51*
General	2,339	143	19	2	0	6	0	2	15	*2,526*	*2,784*	*1.10*
All	**2,507**	**729**	**31**	**4**	**0**	**10**	**23**	**5**	**15**	***3,324***	***4,789***	***1.44***
Time				**9:00–10:00 AM**								
HOV	119	583	32	10	0	9	34	1	0	*788*	*2,363*	*3.00*
General	2,650	176	7	2	0	20	2	3	13	*2,873*	*3,313*	*1.15*
All	**2,769**	**759**	**39**	**12**	**0**	**29**	**36**	**4**	**13**	***3,661***	***5,676***	***1.55***
Time				**6:00–10:00 AM**								
HOV	*518*	*2,372*	*72*	*14*	*0*	*29*	*92*	*9*	*0*	*3,106*	*8,142*	*2.62*
General	*10,514*	*442*	*30*	*4*	*0*	*35*	*20*	*14*	*94*	*11,153*	*12,570*	*1.13*
All	***11,032***	***2,814***	***102***	***18***	***0***	***64***	***112***	***23***	***94***	***14,259***	***20,712***	***1.45***